RELATIVE RESISTANCE OF THE RICE WEEVIL, SITOPHILUS ORYZA L., AND THE GRANARY WEEVIL, S. GRANARIUS L., TO HIGH AND LOW TEMPERATURES[1]

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During several years of study on the grain weevils the writers have observed that the rice weevil, *Sitophilus oryza L.*, and the granary weevil, *S. granarius L.*, although belonging to the same genus and closely resembling each other in size, structure, and habits, differ markedly in their resistance to high and low temperatures. Whereas the rice weevil is predominant in the Middle and Southern States, it has not established itself in the extreme Northern States and is unable to withstand the northern winters except in protected situations. On the other hand, the granary weevil is seldom if ever found in the South below North Carolina, but is the predominant form in the Northern States. In order to obtain more precise information on the relative effects of various temperatures on the two weevils, a number of experiments were carried on in the laboratory with small refrigerator units and incubators, in which the temperatures could be controlled. The results obtained were striking and seemed worthy of record.

A constant temperature of zero Fahrenheit proved quickly fatal to both species, although the granary weevil was able to withstand even this low temperature slightly longer than the rice weevil. Adults of the rice weevil were killed after an exposure of four hours, and adults of the granary weevil after an exposure of five hours, to this temperature.

Up to a certain point, as the temperature was increased, the difference in resistance between the two species became more and more apparent. At a temperature of 5° F. an exposure of four and a half hours was sufficient to kill adults of the rice weevil, whereas an exposure of seven and a half hours at the same temperature was required to kill adults of the granary weevil.

With a temperature ranging from 15° to 20° F., adults of the rice weevil were killed in 3 days and adults of the granary weevil in 14 days. With a temperature ranging from 20° to 25° F. a majority of adults of the rice weevil were killed in 3 days, although a few showed feeble movements after an exposure of 6 days. These longer-lived individuals all died shortly thereafter, without regaining normal activity. Adults of the granary weevil were killed at this temperature only after an exposure of 33 days.

With a temperature ranging from 25° to 30° F., adults of the rice weevil were killed in 8 days and adults of the granary weevil in 46 days, or nearly six times as long. At 30° to 35° F. a majority of adults of the rice weevil were killed in 8 days; a few, however, showed faint movements after an exposure of 16 days, but died without regaining normal activity. An exposure of 73 days at this temperature was necessary to kill adults of the granary weevil.

With a temperature ranging from 35° to 40° F., adults of the rice weevil were killed in 18 days. A few specimens of the granary weevil showed faint movements after being exposed to this temperature for 111 days. With a temperature ranging from 40° to 45° F. adults of the rice weevil were killed in 80 days,

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this slight increase in temperature associating itself with a marked increase in longevity. Specimens of the granary weevil were still alive after an exposure to this temperature for 105 days.

With a temperature ranging from 50° to 60° F., and under the other conditions prevailing, the normal lives of both species of weevil were greatly prolonged. Adults of the rice weevil confined in a refrigerator with this range of temperature lived for a period of 558 days, and specimens of the granary weevil in the same refrigerator for a period of 873 days. The normal life of the rice weevil in summer is from 100 to 200 days, while that of the granary weevil averages from 200 to 250 days.

The immature stages of these two weevils show a similar difference in their powers of resistance to low temperatures. Eggs of the rice weevil perished after being exposed to a constant temperature of 30° F. for 4 days, whereas eggs of the granary weevil survived an exposure to the same temperature for a period of 28 days. Larvæ of the rice weevil were killed by an exposure to a temperature of 30° F. for a period of 11 days, while larvæ of the granary weevil survived an exposure of 44 days to that temperature.

The data previously quoted have been derived from experiments with several thousand individuals. However, the susceptibility to low temperatures varies so much in individuals of the same species that very large numbers must be experimented with in order to arrive at definite conclusions regarding the lethal qualities of any one temperature. The foregoing figures can not be considered quite final until further experiments involving many more individuals have been completed. More detailed results regarding the lethal effect of various low temperatures on the different stages of these two weevils will be published later, when experiments now under way have been completed.

The effect of high temperatures on the two weevils is also of interest, although there are no very great differences in the reactions of the two species to heat. With both species constant temperatures above 95° F. soon prove fatal. Of a large number of adults of the rice weevil confined in an incubator at a temperature ranging from 95° to 98° F., all were killed at the end of 9 days. Adults of the granary weevil confined in the same incubator were all dead at the end of 13 days. A temperature of 120° F. killed adults of both species in three hours, and a temperature of 130° F. within 30 minutes. It is interesting to note that oviposition ceased at a constant temperature of 94° F.